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F. V. HAYDEN,

U. S. GEOLOGIST-IN-CHARGE.

1878.

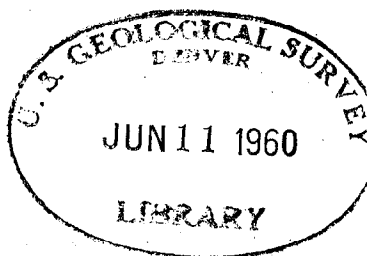
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PART II.—DESCRIPTIONS OF FISHES FROM THE CRETACEOUS AND TERTIARY DEPOSITS WEST OF THE MISSISSIPPI RIVER.

BY E. D. COPE.

TRIAENASPIS VIRGULATUS, Cope, gen. et sp. nov.

Character genericus.—Shape anguilliform; vertebræ elongate, connected medially, furnished with wide and short diapophyses over the abdominal region. Cranium elongate, not beaked; jaws furnished with small teeth of moderate size (but small number in the typical specimen). Dorsal fin short, median in position, its radii cartilaginous. Ventral fins entirely behind dorsal. Caudal and anal fins unknown, the latter probably wanting. The dorsal and ventral surfaces each protected by bony shields. Shields of other forms on the sides.

This, with the genus following, introduces for the first time into the North American extinct fauna the family of the Dercetiform fishes. The relationship of the family has been discussed by various authors, especially by Pictet and Von der Marck. The former regards them as *osteichthyes*; the latter as "Ganoids". As I do not adopt the division suggested by the last name, I find Professor Pictet's view nearer to the truth. The specimens indicate further that the *Dercetidae* belong to the *Actinopteri*, and probably to the order *Hemibranchii*. The only alternative is the order *Isospondyli*, and the characters which separate the two are not clearly shown in the specimens. Distinct bones below the dorsal fins may be interclavicles, which belong to the *Hemibranchii*. Compared with the other genera of this family, *Triænaspis* differs in the very short dorsal fin and posterior position of the ventrals, with probable absence of the anal. The scuta differ in form from those of some genera.

Character specificus.—The head is relatively large and the body slender. The fins are all small. The rami of the mandible do not present any symphysis. The opercula are subround, and the bases of the dorsal fins are quite posterior to them. The dorsal and ventral scuta are triradiate, the median branch of the three being directed anteriorly. A series of smaller triradiate scales extends along the superior lateral margin just below the dorsal row, and there is a similar one above the abdominal row on each side. Between these and the vertebral axis there are numerous narrow, band-like scuta, directed backward and toward the vertebræ. Radii: D. 9 or 10; P. 12 or 13; ventrals disturbed. Vertebræ: to first ray of dorsal fin, 27-28; from dorsal first ray to opposite

base of ventral fin, 10. The dorsal and ventral scuta correspond in number to the vertebrae.

Measurements.

	M.
Length of portion of fish preserved.....	0.121
Length of head.....	0.030
Width of head behind.....	0.008
Depth of body at end of pectoral fin.....	0.0035
Depth of body behind ventral fin.....	0.0070
Depth of dorsal fin.....	0.0070
Length of dorsal fin.....	0.0040

This fish was discovered by *Dr. F. V. Hayden*, Geologist-in-Charge of the United States Geological Survey of the Territories in the Niobrara Cretaceous horizon of Dakota.

LEPTOTRACHELUS LONGIPINNIS, sp. nov.

This species agrees with the type-species of *Leptotrachelus* of Von der Marck in the position of the ventral fins beneath the dorsal, in the great elongation of the anterior vertebrae, and in the lanceolate form of the head. It differs from that species (*L. armatus* v. d. Marck) in its more elongate dorsal fin, in which it approximates the genus *Dercetis*.

Two incomplete specimens represent this species, neither of which possesses the caudal nor exhibits an anal fin. In one of them, the cranium is preserved in a somewhat dislocated condition at the extremity of its very long peduncle. The vertebrae of this region, which might be called a neck, are several times as long as those of the dorsal series. The femoral bones are slender, and commence below the anterior part of the dorsal fin. In one specimen, the ventral fin originates below the twelfth dorsal ray; in the other, below the fifth. As the latter is the least distorted, I suspect the fin to occupy its normal position. The dorsal radii are slender, and the middle and anterior longer than the posterior; they number twenty-seven in one specimen, and nineteen in the other, where the posterior portion is broken away. The ventral rays are hair-like, and do not extend to the line of the distal end of the dorsal. The pectoral fins are well developed, and occupy their usual position. The cranium is much dislocated, but the snout is acute and attenuated. The dermal scuta consist of median, dorsal, and ventral rows of tripodal form. There are some slender, longitudinal, hair-like bodies on the sides, which cross the ribs. The vertebrae present the characteristic elongate centra. The diapophyses are longer on the post-ventral than on the pre-ventral region. Each scutum is as long as a vertebra.

Measurements.

	M.
Length of neck of No. 1.....	0.04
Length of neck to base of dorsal fin.....	0.07
Length of base of dorsal fin.....	0.02
Elevation of dorsal fin.....	0.00

Length of body just behind dorsal fin.....	0.006
Length of body in front of dorsal (No. 2).....	0.010
Length of vertebrae measure (No. 2).....	0.017
Length of ventral fin (No. 2).....	0.016

Discovered by *Dr. F. V. Hayden* in the Niobrara Cretaceous of Dakota.

This fish is particularly welcome, as displaying generic identity with species of the Westphalian Chalk, and with a third, from the Slates of Mount Lebanon. It thus indicates a closer relation between these than could be predicated on the discovery of the family to which it belongs. The horizon of Mount Lebanon has been regarded as Cretaceous, but Heckel and Von der Marck place it in the Upper Cretaceous. The conclusion of these paleontologists, the discovery of this and other species described in this paper lends support.

ORTHYOTRINGA TENUIROSTRIS, gen. et sp. nov.

Character genericus.—Head attenuated and produced into a beak; jaws with weak teeth, of equal lengths. Dorsal fin small, composed of few rays. Body covered with small, round scales. Vertebrae sub-elongate.

The specimens representing this genus are so far imperfect that the dorsal and anal fins remain unknown. But they show clearly that it differs from the genera which appear to be related, namely, *Dercetis* and *Rhinellus*, in the absence of dermal scuta and in the short dorsal fin. But one species has come under my observation.

Character specificus.—The dorsal fin is about half as far behind the snout as the length of the latter. It is supported by well developed pre-neural spines; but these elements do not exist in front of it. The snout is very slender, the mouth apparently opening to behind the orbit. The scales closely imbricate, in about twenty longitudinal series, above the vertebral line of the side. Dorsal radii, II. (rudimental), 12. The anterior supplementary ribs are numerous.

Measurements.

	M.
Length to opercular border.....	0.043
Length to base of first dorsal ray.....	0.061
Length of base of dorsal fin.....	0.006
Elevation of dorsal fin.....	0.010
Length to vertebral column between dorsal fin and head.....	0.005
Length of vertebrae.....	0.006

From Cretaceous No. 3 of Dakota (*Dr. F. V. Hayden*).

PHODON SIMUS, sp. nov.

Another genus of the Lebanon is represented in the collections from the same horizon by a rather abundant species. The elongate anterior teeth of the mandible and the edentulous maxillary are exhibited by the

new species; but I am unable to find the long premaxillary teeth said to exist in the typical species of *Spaniodon*. As the absence of these may be due to accident, and as all other characters coincide, I leave it under this genus. From the known genera of *Sauroidontidae* of the same horizon, the edentulous maxillary bone, combined with long dentaries with round section, and the absence of pectoral and ventral spines, separate it. To the characters named, I may add that there are no dermal scuta, but cycloid dorsal scales. Whether the body was scaly below the lateral line is not clear from our specimens.

There are numerous slender branchiostegal rays. The pectoral fins are inferior; the dorsal is not large, is composed of soft rays, and is submedian in position. The ventral fins originate behind it, and the anal fin still more posteriorly, leaving a long abdominal cavity. The ribs are long, and the superior ribs numerous. The femora are elongate, and are narrowed and converging anteriorly. They do not appear to be fissured. The dorsal centra are not elongate, and are grooved.

Character specificus.—Three specimens, more or less mutilated, represent this fish; one of these is almost entire, and serves as the type of my description.

The gape of the mouth is wide, and is directed forward and upward. The extremity of the muzzle is the premaxillary bone, and this is concave backward, so as to give, with the oblique mouth, a bulldog expression. The superior profile is gently concave. The opercular apparatus is produced slightly downward and backward, so that the posterior depth of the head equals its length. The partly opened mouth displays two long, straight, acute teeth on the anterior extremity of the dentary bone. The pectoral fins are large, while the ventrals are small. The anal is moderate, and has a concave border. Radii: D. 11. 20; A. 11. 14; V. 8; P. 14. Vertebrae: D. 32; C. 13. Anterior dorsals not different from the others.

Measurements.

Total length	0.160
Length to opercular border (axial)	0.047
Length to dorsal fin (axial)	0.072
Length to ventral fin (axial)	0.100
Length to anal fin (axial)	0.117
Length to caudal fin (axial)	0.132
Depth of head posteriorly	0.032
Depth of body at dorsal fin	0.032
Depth of body at first anal ray	0.020
Depth of caudal peduncle	0.012

This genus is one of the *Isospondyli*.

SARDINIUS NASUTULUS, *sp. nov.*

This species is referred to a genus established by von der Marck for three species of *Isospondylous*, and probably *Clupeoid* fishes, which have been found in the Upper Cretaceous of Westphalia. They present mostly negative characters, resembling *Clupea*, without abdominal no-

phalic serration, and with minute teeth. The fishes here referred to this genus do not exhibit any teeth; but as my specimens, five in number, are small, it is not certain that adults may not display them. The presence or absence of teeth is not a constant character in all *Clupea*, according to Günther. *Leptosomus* v. d. Marck does not appear to differ from *Sardinus*.

The *Sardinus nasutulus* is a small species of moderately elongate form, with a rather long head and protuberant muzzle. The dorsal fin originates in front of the middle of the body, and the ventral fins take their rise immediately below its anterior rays. The anal originates behind the line of the dorsal, but far enough forward to leave an elongate caudal peduncle, which is also quite stout. The pectoral fins reach nearly to the base of the ventrals. Radii: D. 9; A. 11, about; V. about 10. The boundaries of the scales are difficult to define on the specimens, but there do not appear to be more than eight or ten longitudinal series. Their sculpture consists exclusively of concentric grooves. There are fourteen dorsal and fifteen caudal vertebrae, all with long and slender neural spines. Of the former, five are anterior to the first interanal bone, which is directed downward; the last caudal vertebra is slender and turned upward. The scales are very much attenuated, so that their number cannot be made out. The ribs are stout for the size of the fish. The superior surface of the head is rather narrow, and ends with straight borders to the muzzle.

Measurements.

Length of head (including operculum)	M. 0.0115
Length to base of dorsal fin (axial)	0.0175
Length to base of ventral fin (axial)	0.0170
Length to base of anal fin (axial)	0.0280
Length to base of caudal fin (axial)	0.0410
Length of base of dorsal fin	0.0055
Length of base of anal fin	0.0057
Length of skull between orbits	0.0010
Length of body at first dorsal ray	0.0065
Length of body at middle of caudal peduncle	0.0050

Libraria Cretaceous No. 3 of Dakota (*Dr. Hayden*).

SARDINIUS LINEATUS, *sp. nov.*

Two specimens of similar small size constitute the basis of information respecting this species. Many characters can be derived from these, but the dorsal fin being absent from one of them, and the ventral and posterior part of the body from the other, the mutual relation of these fins is not ascertained. The form is very elongate, and the head is lanceolate. The dorsal fin is distant from both cranium and anal fin. The fins are composed of slender rays, and the anal is not elongate; the caudal is deeply forked, and no vertebrae are included in the basis of its external rays, although four are embraced within the convergent lines of the anterior upper and lower fulcrum. The ver-

tebræ are short, and the neural and hæmal spines are well developed while the ribs are weak. Vertebræ: Dorsals to first descending interneural spine, 19; of the caudal series, 12.

There is no indication of an adipose fin. The posterior portion of the dorsal fin is lost, so that the number of rays cannot be ascertained; nine interneurals remain. The pectoral fin is long and slender, but does not reach to the ventral. Anal rays not elongate, nine in number. The bones of the head are so thin that their boundaries are not easily determined. The opercular apparatus is well developed, and there are two approximated parallel ridges on what appears to be the top of the head. The scales are so thin that their number is not ascertainable. A peculiarity of the species, from which it derives its name, is that its sides are marked by longitudinal bands of a darker color than the intervening spaces. There are six above the vertebral column and six below it. I cannot determine that this appearance is due to rows of scales, but they rather seem to be true color-stripes.

Measurements.

	M.
Length of head of No. 1.....	0.012
Length to base of dorsal fin.....	0.032
Depth half-way between head and dorsal fin.....	0.006
Length of caudal region of No. 2.....	0.019
Length of caudal fin.....	0.009
Depth at first anal ray.....	0.005
Depth at base of caudal fin.....	0.004

Niobrara Cretaceous of Dakota; found by Dr. Hayden.

SARDINIUS PERCRASSUS, sp. nov.

The block which contains specimens of *Trienaspis virgulatus*, *Leptotrachelus longipinnis*, *Sardinus lineatus*, and another species undetermined, contains also the very distinct fish now described under the name at the head of this paragraph. It is distinguished from the other *Sardinii* by its very robust form, and from the *S. nasutus* by the origin of the ventral fin being behind the perpendicular of the first dorsal ray.

The anterior part of the head is damaged; the operculum is distinct. There is an elongate postclavicle, and the position of the small pectoral fin is normal. The origin of the dorsal fin is much nearer the head than to the caudal fin; its rays, like those of all the other fins, are slender. The ventrals originate under the fifth dorsal ray, and are supported by slender femora, which appear to be undivided, and converge to an acute junction anteriorly. The anal fin is short and entirely behind the dorsal. The neural spines and interneurals and interhæmals are weak, while the ribs are strong. The caudal peduncle is exceedingly stout, nearly equalling the body. Radii: D. 10; A. 9; V. 6. Vertebræ: D. 14, four anterior to first interneural; C. 13. The scales are too attenuated to be counted. It is quite possible that this species possesses an adipose dorsal fin, in which case its present generic reference must be abandoned. Better specimens only can solve this question.

Measurements.

	M.
Total length (head imperfect).....	0.040
Length to opercular border.....	0.010
Length to first dorsal ray (axial).....	0.013
Length to first ventral.....	0.016
Length to first anal.....	0.023
Length to base of caudal fin.....	0.032
Length of base of dorsal fin.....	0.005
Length of base of anal fin.....	0.002
Depth at first dorsal ray.....	0.011
Depth at first anal ray.....	0.009
Depth at base of caudal fin.....	0.0065

From the Niobrara Cretaceous of Dakota; from Dr. F. V. Hayden.

TRICHOPHANES FOLIARUM, sp. nov.

The Tertiary shales of Florissant in the South Park of Colorado have already yielded numerous species of plants, insects, and fishes, which have been described by Messrs. Lesquereux, Scudder, and myself.* Six species of fishes have been determined, three of which pertain to the genus of *Catostomidae*, which I had originally procured from the paper coal of Osino, Nevada. On this ground, an approximation of the horizons of the two localities was made. I now record the occurrence of a species of the second genus found in the Osino coal, *Trichophanes*, of which the *T. hians* has been up to the present time the only one known. The epochal identification of the two formations is thus confirmed.

The *Trichophanes foliarum* is represented by a larger individual than the *T. hians*, but which wants the posterior part of the body, including the caudal and part of the anal fin. The generic and family characters are, however, very clearly visible in the anterior portion of the skeleton.

The premaxillary bone forms all or nearly all of the superior arcade of the mouth. There are a few rows of small equal teeth *en brosse* on the premaxillary bone. Four rather wide branchiostegal rays are visible in the specimen. The posterior superior angle of the operculum (which is displaced in the specimen) is drawn out into an acute short spine. There is a row of small teeth *en brosse* probably on the palatine or pterygoid bone. The anterior vertebræ are unmodified, and the centra are not elongate. A strong acute spine supports the dorsal fin, and a similar one the anal fin in front. There is an elongate postclavicle on each side, which extends parallel with the femur to the base of the ventral fin. The femur is divided; the external portion is straight, and extends to the opericle, while the other portion is curved inward and forward, reaching the apex of the corresponding bone of the opposite side. Ventral radii,

The dorsal fin originates above the ventral fin. The scales are peculiar, and characteristic of the genus. They are very thin, and without or with minute sculpture. Their borders are fringed with long, closely-set, bristle-like processes, which correspond to the teeth of the ganoid scale.

This genus, *Amphiplaga*, and *Erismatopterus* form a group which probably belongs to the family of *Aphroderidae*, which is represented in American waters by the recent genera *Aphroderidius* and *Sternotremia*. The present species, the only one in which the parts are large enough and sufficiently well preserved for observation, exhibits the furcate character of the femora, which characterizes the family in question among Physoclostous fishes.

Character specificus.—The scales extend on the cheeks and abdomen; there are nine or ten longitudinal rows above the vertebral column and about sixteen below it. The head is moderately elongate and deep behind. The mouth is subterminal, and the extremity of the premaxillary bone extended backward would reach about half-way to the orbit. Ribs stout; neural spines slender. The interneurals visible number 11, but the posterior part of the dorsal fin is wanting. These bones have thin anterior and posterior laminar expansions. The anterior interneural strikes the fifth vertebra from the head; between this one and the first interhæmal there are nine vertebrae.

Measurements.

	M.
Length of head to first vertebra.....	0.023
Depth of head posteriorly.....	0.022
Length of mandibular ramus.....	0.013
Length to scapula.....	0.035
Length to dorsal fin.....	0.050
Depth at middle of dorsal fin.....	0.023

From the Tertiary shale of Florissant, Colorado; discovered by my friend *Dr. S. H. Scudder*, of Boston, collaborator of the United States Geological Survey of the Territories.

PRISCACARA OXYPRION, *sp. nov.*

Five specimens in nearly complete preservation represent this species in our collections. It is more nearly allied to the *P. serrata* than to the other species, as the spine of the ventral fin is large and robust. It differs from that and from all the other known species of the genus in the small number of the radii of its anal fin. It agrees with *P. serrata* in the small number of the rays of the second dorsal. It is a smaller species than the *P. serrata*, being intermediate in size between it and the *P. pealei*. It is especially marked by the long, acute serræ of the entire posterior and inferior margins of the preoperculum. The operculum, suboperculum, and cheek are scaled; the preoperculum is naked.

Formula: Br. VIII; D. X—11; V. I—5; A. III—8; Vert. D. 10; Caud. 14. The form is an elongate oval, rather more elongate than any other species of the genus. The mouth is terminal and the front gently convex and descending. The length of the head enters the total, less the caudal fin, two and a half times, and the greatest depth is half of the same. The dorsal spines are long and strong, the longest equalling the soft rays in length. The anal spines are very robust, the second or

longest not equalling the longest soft rays of the same fin. The origin of the first spine is below the first ray of the soft dorsal. There are three long and one short interneural bones in front of the dorsal fin. The origin of the ventral is below the third (or fourth) dorsal spine. The vertebrae have two fossæ on each side, separated by a ridge. The jaws are edentulous. The scales are small and the specimens very well preserved.

In the largest specimen, I count, in a vertical line drawn from the first dorsal soft ray to the middle of the abdominal line, fifteen longitudinal rows of scales above and twenty-five below the vertebral column. On the opercular flap of a smaller, the typical specimen, I count nine vertical and fourteen transverse rows of scales.

Measurements.

	M.
Length of type-specimen.....	0.137
Length to base of caudal fin.....	0.109
Length to apex of first interhæmal.....	0.067
Length of head.....	0.040
Length of third dorsal spine.....	0.024
Length of second anal spine.....	0.018
Length of pectoral spine.....	0.019
Length at first dorsal spine.....	0.050
Length at first anal spine.....	0.041
Length of caudal peduncle.....	0.019

The lateral line is visible in the largest specimen. It extends parallel to the dorsal border, marking at its greatest convexity less than one-third the distance from the vertebral column to the dorsal outline. It appears behind the vertebral column below the seventh soft dorsal spine and does not reappear.

This fish came from a deposit of the Green River Shales on Bear River, Wyoming.

PRISCACARA PEALEI, *sp. nov.*

Outline elliptic, with the extremities contracting equally or symmetrically to the head and tail. Depth at ventral fins entering length (with anal fin) 2.60 times. Mouth rather small; length of head entering length 3.8 times. Short conic teeth *en brosse*. Preorbital and preopercular bones finely serrated on their free margins. Vertebrae: D. 7; A. III—14; V. I—5 or 6. The dorsal spines are slender; the anal spines are stouter, but shorter; the ventral spine is weak and slender. The ventral fin when appressed against the body fails to reach the anal fin by a space a little greater than the length of the ventral spine; its origin is beneath the third dorsal spine. The scales are difficult to observe on the specimens, but there are not less than 15 to 17 longitudinal rows along the abdomen in front of the anal fin.

Measurements.

Total length	0.130
Axial length of head	0.035
Axial length to first dorsal spine	0.038
Axial length to first dorsal soft ray	0.062
Axial length to first anal spine	0.070
Axial length to base of caudal fin	0.103
Depth at orbit	0.025
Depth at first anal spine	0.041
Depth of caudal peduncle	0.016
Length of fifth dorsal spine	0.018

This species is similar in size and proportions to the *Priscacara liops*, but differs in having constantly but seven dorsal or abdominal vertebrae, while that species presents nine. I have not observed any serratures on the preoperculum of the *P. liops*, but the typical specimens are imperfect in that region, although good impressions of it remain on the matrix.

Two complete specimens present all the characters of this species, while in two others all the more important ones can be seen. Two additional specimens may be referred to it with the greatest probability. Some of these were obtained by Dr. A. C. Peale, in charge of one of the parties under Dr. F. V. Hayden, from the shales of the Green River formation of Wyoming. The species is dedicated to Dr. Peale in recognition of his services to geological science.

PRISCACARA CLIVOSA, *sp. nov.*

The species of *Priscacara* are referrible to two sections. In the first the ventral spine is very strong, and there are but ten or eleven soft dorsal radii: here belong *P. serrata*, *P. cypha*, and *P. oxyprion*. In the second, the first ventral spine is weak and slender, and there are thirteen or fourteen radii of the second dorsal fin: in this division belong *P. liops*, *P. pealei*, and *P. clivosa*.

In the last-named fish, there are eight dorsal and fourteen caudal vertebrae. Radii: D. X—13; A. III—11. The ventral fin appressed, nearly reaches the base of the anal, a point in which it differs materially from the two allied species. Another characteristic is the form of the profile, which resembles that of some of the species of *Geophagus*. The dorsal fin descends steeply from a point just anterior to the base of the dorsal fin giving an obliquity to that part of the outline and an inferior position to the mouth. The vertebral column is more arched anteriorly, appropriately to the prominence of the anterior dorsal region. The depth at the base of the first dorsal fin enters the total length (with caudal fin) 2.6 times, and the length of the head 3.6 times in the same.

Measurements.

Total length	0.11
Axial length of head	0.03
Axial length to line of first dorsal	0.03

..... length to origin of ventral fin	0.041
..... length to origin of anal fin	0.057
..... length to origin of second dorsal fin	0.056
..... length to origin of caudal fin	0.082
..... depth of caudal peduncle	0.016

The preopercular border is not visible in the only specimen of this species known to me. The operculum is scaly. There are 11–13 rows of scales on a line from the vertebral column to the abdominal border. I note here that further examination shows that there are from 20 to 25 longitudinal rows of scales on the side of the abdomen of *P. serrata*, and the number is not exactly determinable, owing to the condition of the specimens.

PEDOGLOSSUS AEQUIPINNIS, *sp. nov.*

Two specimens present the principal character of this species, viz, inequality in number of rays in the dorsal and anal fins and the near equality in their size. The radii are in one, D. 23; A. 22: in the other, D. 22; A. 22. In *D. testis*, the formula is D. II—18; A. II—26. The vertebral number in one of the specimens of *D. aequipinnis* number, D. 19; C. 27: while in *D. testis* there are, D. 18; C. 24–25. (The number, 21 dorsal, originally given, must be corrected, as based on an imperfect specimen.) In *D. aequipinnis*, the first pectoral ray is not so largely developed as in *D. testis*, not being of unusual size. The hyoid apparatus and vomer are closely studded with teeth, as required by the generic character.

Measurements.

..... length of No. 1	M.
..... length of head of No. 1	0.051
..... length to line of anal fin	0.014
..... length to line of dorsal	0.030
..... length to origin of caudal	0.028
..... depth of head	0.040
..... depth at first dorsal ray	0.012
..... depth of caudal peduncle	0.008
..... length of No. 2	0.004
..... depth at middle of dorsal line	0.092
..... depth at base of dorsal fin	0.032
..... depth of caudal peduncle	0.024
..... depth of caudal peduncle	0.008

The specimens described are much smaller than those of the *D. testis* known, but No. 1 is probably young. This fact will not account for the peculiarity of the radial formula, etc.

I add here that there are two vertebrae included within the caudal fin of *Pedoglossus*.